

11

tive target, which is arranged in the vacuum chamber, onto the surface of the lower TiN electrode.

14. The method according to claim 10, wherein the plurality of metal or metal nitride nano-particles comprise a pair of nano-particles laterally spaced by the amorphous SiO₂ or amorphous Al₂O₃ dielectric.

15. A method, comprising:

providing a semiconductor substrate with a plurality of semiconductor devices arranged thereon, wherein an interconnect structure, which comprises a plurality of conductive lines and vias within a dielectric structure, is formed over the semiconductor substrate to couple semiconductor devices to one another;

forming a conductive lower electrode over the interconnect structure; and

performing a co-sputtering process to form a dielectric directly over the conductive lower electrode, wherein during the co-sputtering process a dielectric material and a conductive material are concurrently sputtered from different targets, and nano-particles of metal oxide or of metal nitride form on the conductive lower electrode from the conductive material, to form the dielectric, wherein the dielectric has a linear relationship between an electric field applied thereto and polarization induced therein by the electric field, and wherein the conductive material is an elemental metal.

12

16. The method of claim 15, wherein the co-sputtering process comprises:

arranging the semiconductor substrate on an engagement surface within a vacuum chamber;

while the semiconductor substrate is on the engagement surface, using a first direct current (DC) bias to sputter the dielectric material from a dielectric target, which is arranged in the vacuum chamber, onto a surface of the conductive lower electrode; and

while the dielectric material is being sputtered from the dielectric target, using a second DC bias to concurrently sputter conductive particles from a conductive target, which is arranged in the vacuum chamber, onto the surface of the conductive lower electrode.

17. The method of claim 16, wherein the first DC bias is larger than the second DC bias.

18. The method of claim 15, wherein the dielectric material is made up of an amorphous oxide or amorphous nitride matrix and a series of metal or metal oxide or metal nitride particles that are randomly distributed over a volume of the amorphous oxide or amorphous nitride matrix.

19. The method of claim 18, wherein the amorphous oxide or amorphous nitride matrix is made up of amorphous SiO₂.

20. The method of claim 18, wherein the metal or metal oxide or metal nitride particles include Ti, Zr, Hf, or a combination of the foregoing.

* * * * *